

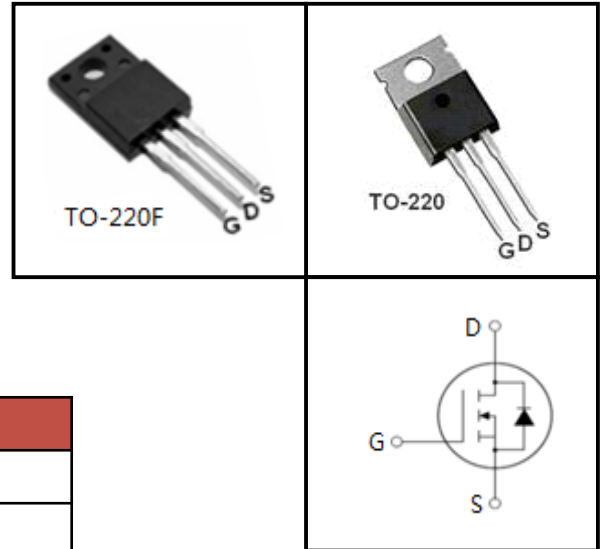
## 600V N-Channel MOSFET

### FEATURES

- Fast switching
- 100% avalanche tested
- Improved dv/dt capability

### APPLICATIONS

- Switch Mode Power Supply (SMPS)
- Uninterruptible Power Supply (UPS)
- Power Factor Correction (PFC)



### Device Marking and Package Information

| Device   | Package | Marking  |
|----------|---------|----------|
| CS16N60F | TO-220F | CS16N60F |
| CS16N60P | TO-220  | CS16N60P |

### Absolute Maximum Ratings $T_C = 25^\circ\text{C}$ , unless otherwise noted

| Parameter                                        | Symbol         | Value           |        | Unit             |
|--------------------------------------------------|----------------|-----------------|--------|------------------|
|                                                  |                | TO-220F         | TO-220 |                  |
| Drain-Source Voltage ( $V_{GS} = 0V$ )           | $V_{DSS}$      | 600             |        | V                |
| Continuous Drain Current                         | $I_D$          | 16              |        | A                |
| Pulsed Drain Current (note1)                     | $I_{DM}$       | 64              |        | A                |
| Gate-Source Voltage                              | $V_{GSS}$      | $\pm 30$        |        | V                |
| Single Pulse Avalanche Energy (note2)            | $E_{AS}$       | 376             |        | mJ               |
| Avalanche Current (note1)                        | $I_{AS}$       | 8.7             |        | A                |
| Repetitive Avalanche Energy (note1)              | $E_{AR}$       | 225             |        | mJ               |
| Power Dissipation ( $T_C = 25^\circ\text{C}$ )   | $P_D$          | 63.7            | 104    | W                |
| Operating Junction and Storage Temperature Range | $T_J, T_{stg}$ | $-55 \sim +150$ |        | $^\circ\text{C}$ |

### Thermal Resistance

| Parameter                               | Symbol     | Value   |        | Unit |
|-----------------------------------------|------------|---------|--------|------|
|                                         |            | TO-220F | TO-220 |      |
| Thermal Resistance, Junction-to-Case    | $R_{thJC}$ | 1.96    | 1.2    | K/W  |
| Thermal Resistance, Junction-to-Ambient | $R_{thJA}$ | 62.5    | 60     |      |

**Specifications**  $T_J = 25^{\circ}\text{C}$ , unless otherwise noted

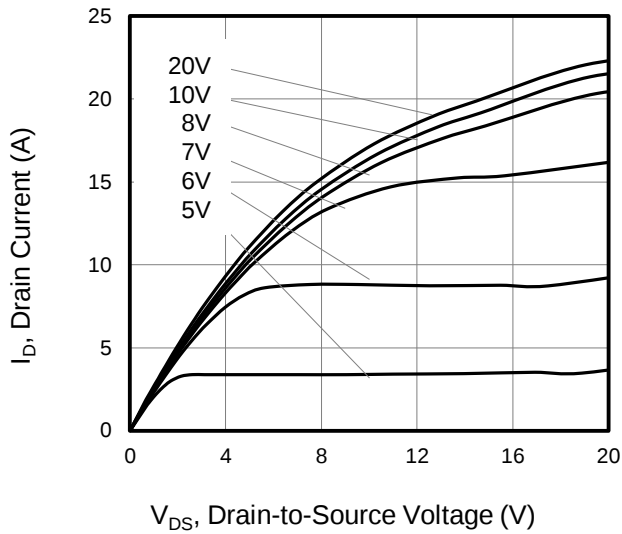
| Parameter                               | Symbol               | Test Conditions                                                              | Value |      |      | Unit |
|-----------------------------------------|----------------------|------------------------------------------------------------------------------|-------|------|------|------|
|                                         |                      |                                                                              | Min.  | Typ. | Max. |      |
| Static                                  |                      |                                                                              |       |      |      |      |
| Drain-Source Breakdown Voltage          | V <sub>(BR)DSS</sub> | V <sub>GS</sub> = 0V, I <sub>D</sub> = 250μA                                 | 600   | --   | --   | V    |
| Zero Gate Voltage Drain Current         | I <sub>DSS</sub>     | V <sub>DS</sub> = 600V, V <sub>GS</sub> = 0V, T <sub>J</sub> = 25°C          | --    | --   | 1    | μA   |
| Gate-Source Leakage                     | I <sub>GSS</sub>     | V <sub>GS</sub> = ±30V                                                       | --    | --   | ±100 | nA   |
| Gate-Source Threshold Voltage           | V <sub>GS(th)</sub>  | V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = 250μA                   | 3.0   | --   | 4.0  | V    |
| Drain-Source On-Resistance (Note3)      | R <sub>DS(on)</sub>  | V <sub>GS</sub> = 10V, I <sub>D</sub> = 8.0A                                 | --    | 0.4  | 0.48 | Ω    |
| Dynamic                                 |                      |                                                                              |       |      |      |      |
| Input Capacitance                       | C <sub>iss</sub>     | V <sub>GS</sub> = 0V,<br>V <sub>DS</sub> = 25V,<br>f = 1.0MHz                | --    | 2006 | --   | pF   |
| Output Capacitance                      | C <sub>oss</sub>     |                                                                              | --    | 214  | --   |      |
| Reverse Transfer Capacitance            | C <sub>rss</sub>     |                                                                              | --    | 30   | --   |      |
| Total Gate Charge                       | Q <sub>g</sub>       | V <sub>DD</sub> = 480V, I <sub>D</sub> = 16A,<br>V <sub>GS</sub> = 10V       | --    | 62   | --   | nC   |
| Gate-Source Charge                      | Q <sub>gs</sub>      |                                                                              | --    | 10   | --   |      |
| Gate-Drain Charge                       | Q <sub>gd</sub>      |                                                                              | --    | 29   | --   |      |
| Turn-on Delay Time                      | t <sub>d(on)</sub>   | V <sub>DD</sub> = 300V, I <sub>D</sub> =16A,<br>R <sub>G</sub> = 25 Ω        | --    | 50   | --   | ns   |
| Turn-on Rise Time                       | t <sub>r</sub>       |                                                                              | --    | 43   | --   |      |
| Turn-off Delay Time                     | t <sub>d(off)</sub>  |                                                                              | --    | 243  | --   |      |
| Turn-off Fall Time                      | t <sub>f</sub>       |                                                                              | --    | 70   | --   |      |
| Drain-Source Body Diode Characteristics |                      |                                                                              |       |      |      |      |
| Continuous Body Diode Current           | I <sub>S</sub>       | T <sub>C</sub> = 25 °C                                                       | --    | --   | 16   | A    |
| Pulsed Diode Forward Current            | I <sub>SM</sub>      |                                                                              | --    | --   | 64   |      |
| Body Diode Voltage                      | V <sub>SD</sub>      | T <sub>J</sub> = 25°C, I <sub>SD</sub> = 8A, V <sub>GS</sub> = 0V            | --    | --   | 1.4  | V    |
| Reverse Recovery Time                   | t <sub>rr</sub>      | V <sub>GS</sub> = 0V, I <sub>S</sub> = 16A,<br>di <sub>F</sub> /dt =100A /μs | --    | 620  | --   | ns   |
| Reverse Recovery Charge                 | Q <sub>rr</sub>      |                                                                              | --    | 3.84 | --   | μC   |

**Notes**

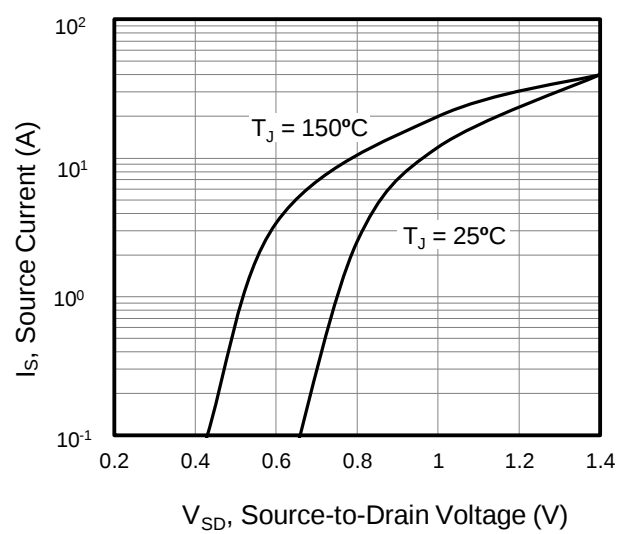
1. Repetitive Rating: Pulse width limited by maximum junction temperature
2.  $L = 10.0mH, V_{DD} = 50V, R_G = 25\Omega$ , Starting  $T_J = 25^{\circ}\text{C}$
3. Pulse Test: Pulse width  $\leq 300\mu s$ , Duty Cycle  $\leq 1\%$

**Typical Characteristics**  $T_J = 25^\circ\text{C}$ , unless otherwise noted

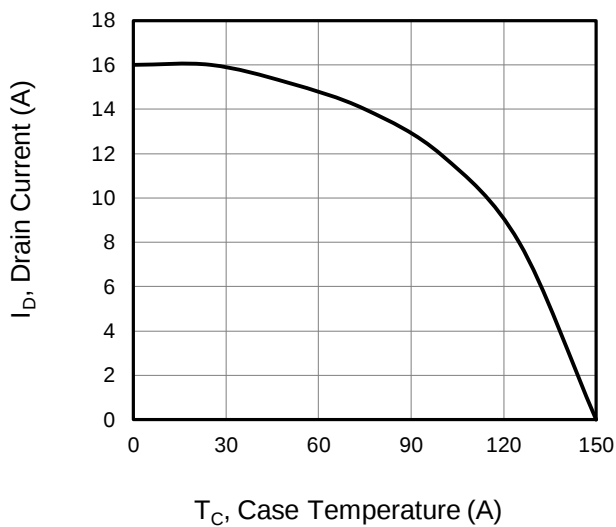
**Figure 1. Output Characteristics ( $T_J = 25^\circ\text{C}$ )**



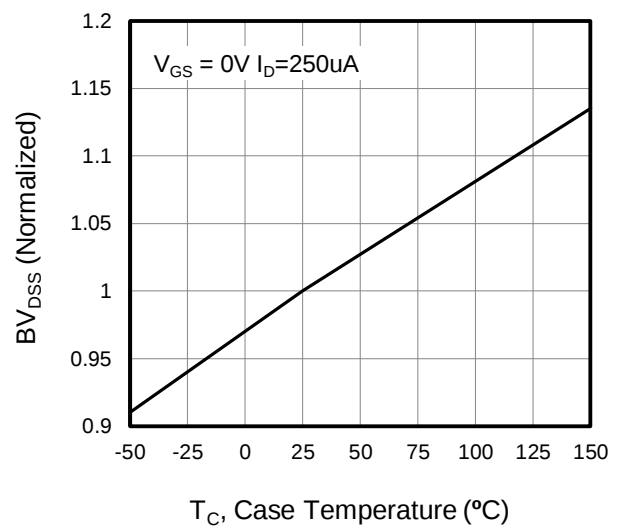
**Figure 2. Body Diode Forward Voltage**



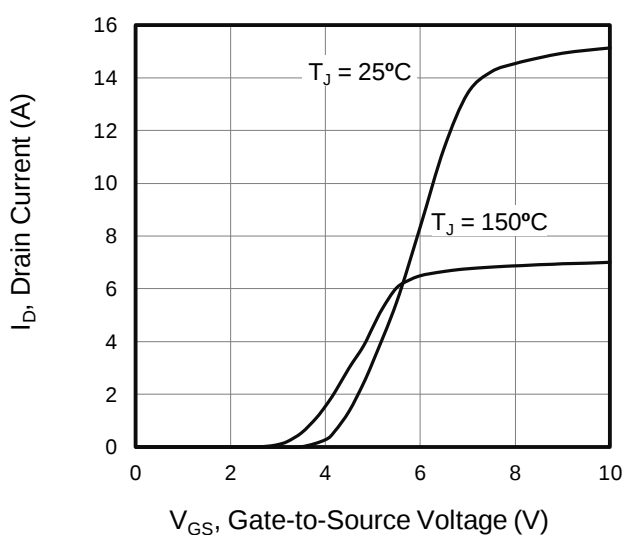
**Figure 3. Drain Current vs. Temperature**



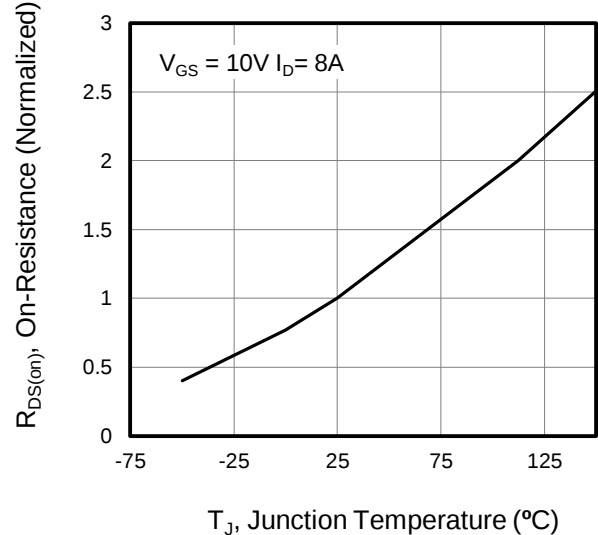
**Figure 4.  $BV_{DSS}$  Variation vs. Temperature**



**Figure 5. Transfer Characteristics**



**Figure 6. On-Resistance vs. Temperature**



Typical Characteristics  $T_j = 25^\circ\text{C}$ , unless otherwise noted

Figure 7. Capacitance

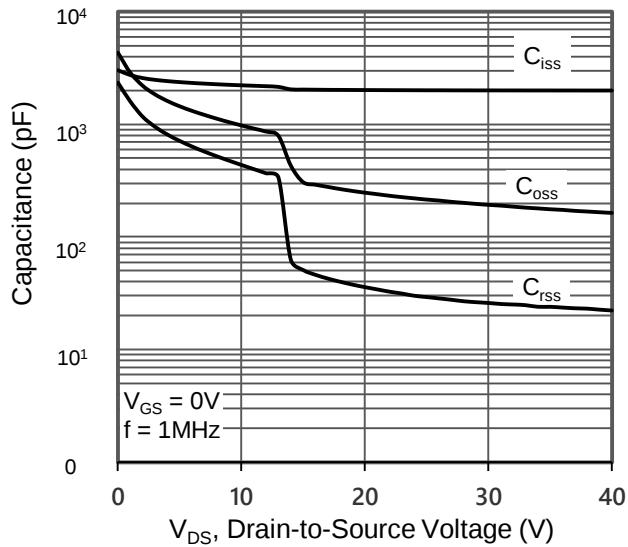


Figure 8. Gate Charge

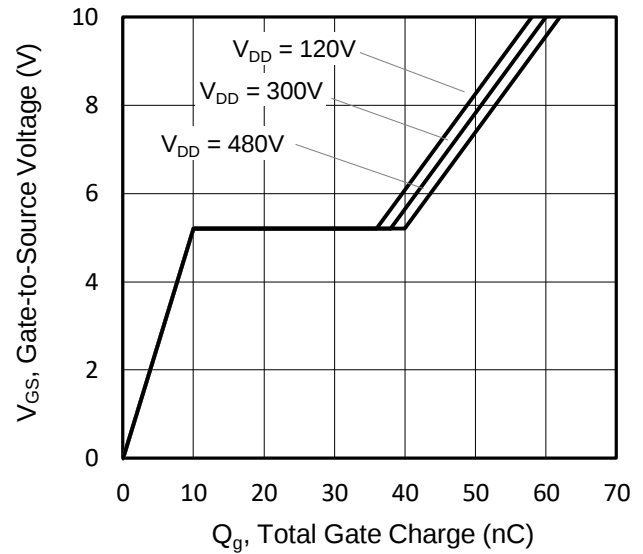


Figure 9. Transient Thermal Impedance  
TO-220F

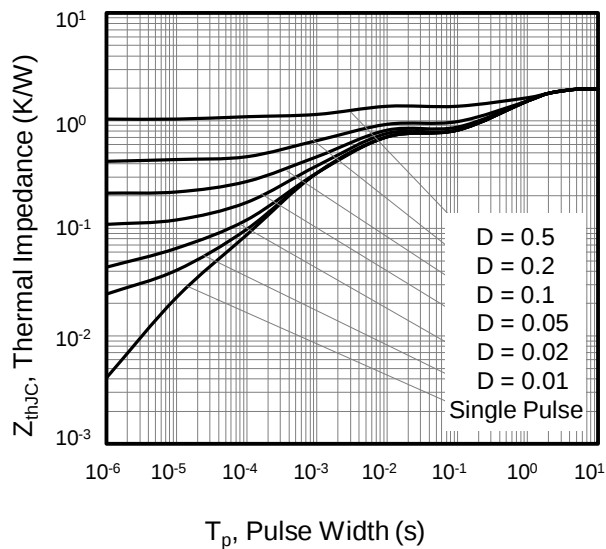
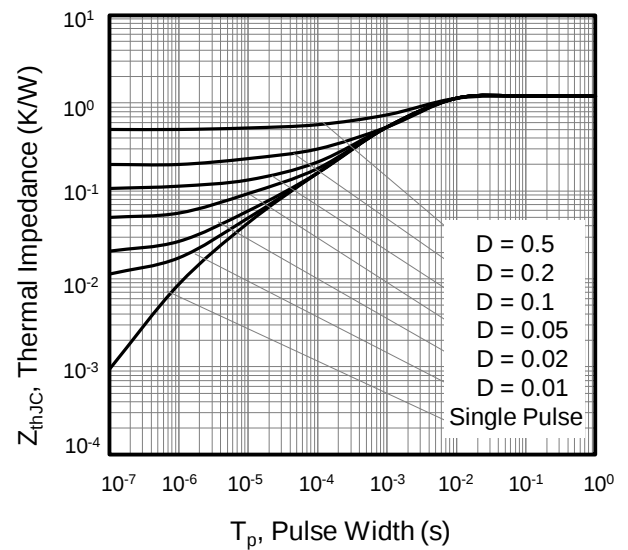
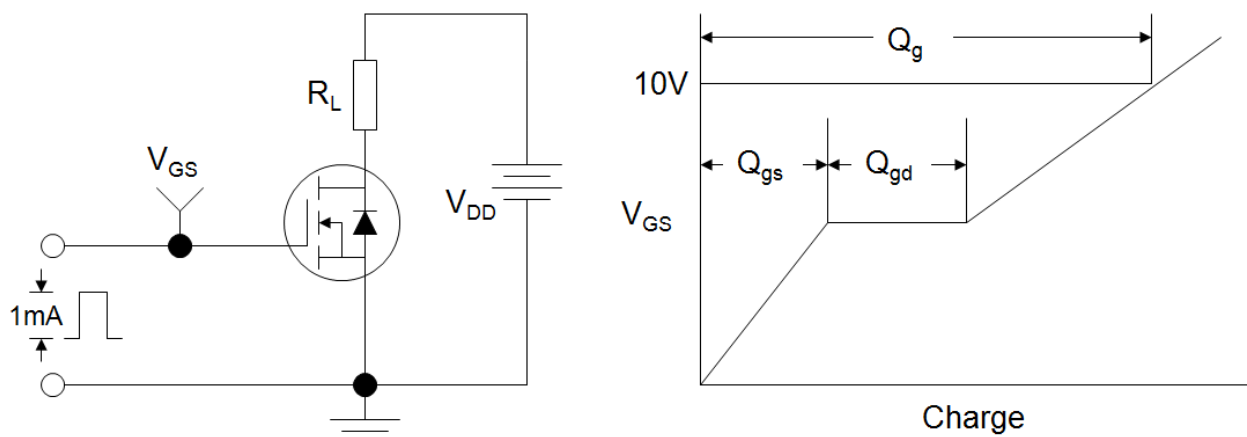
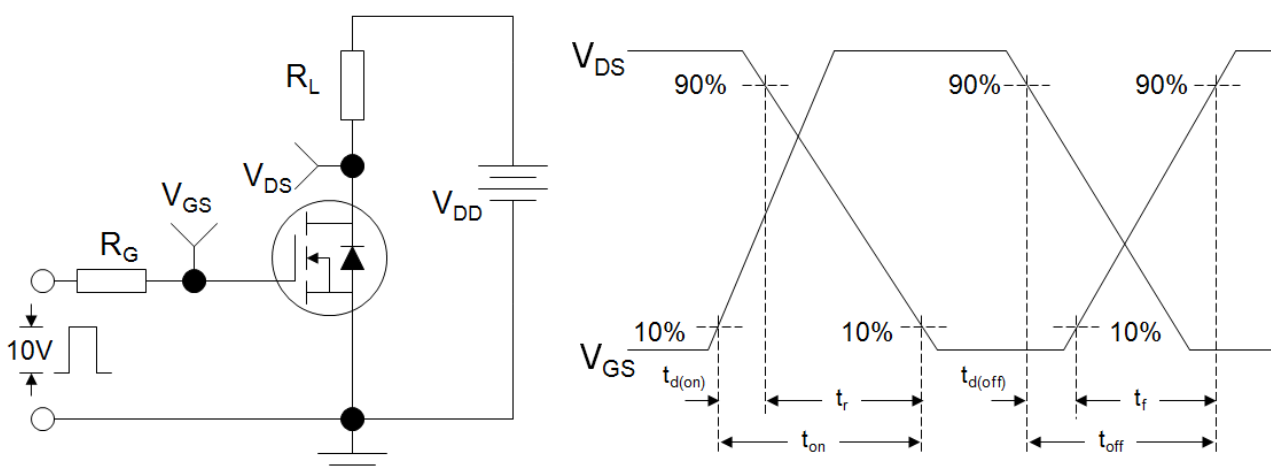
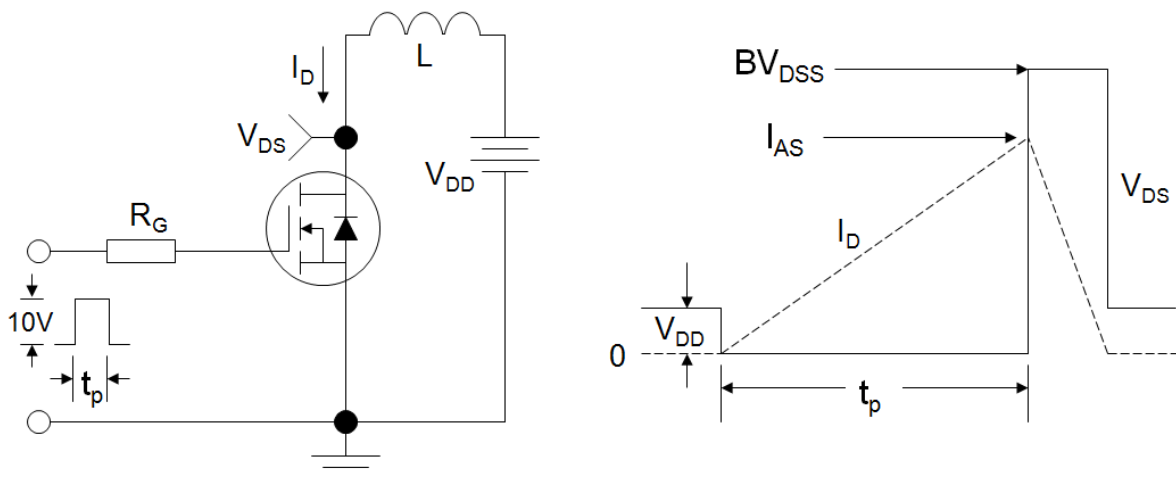
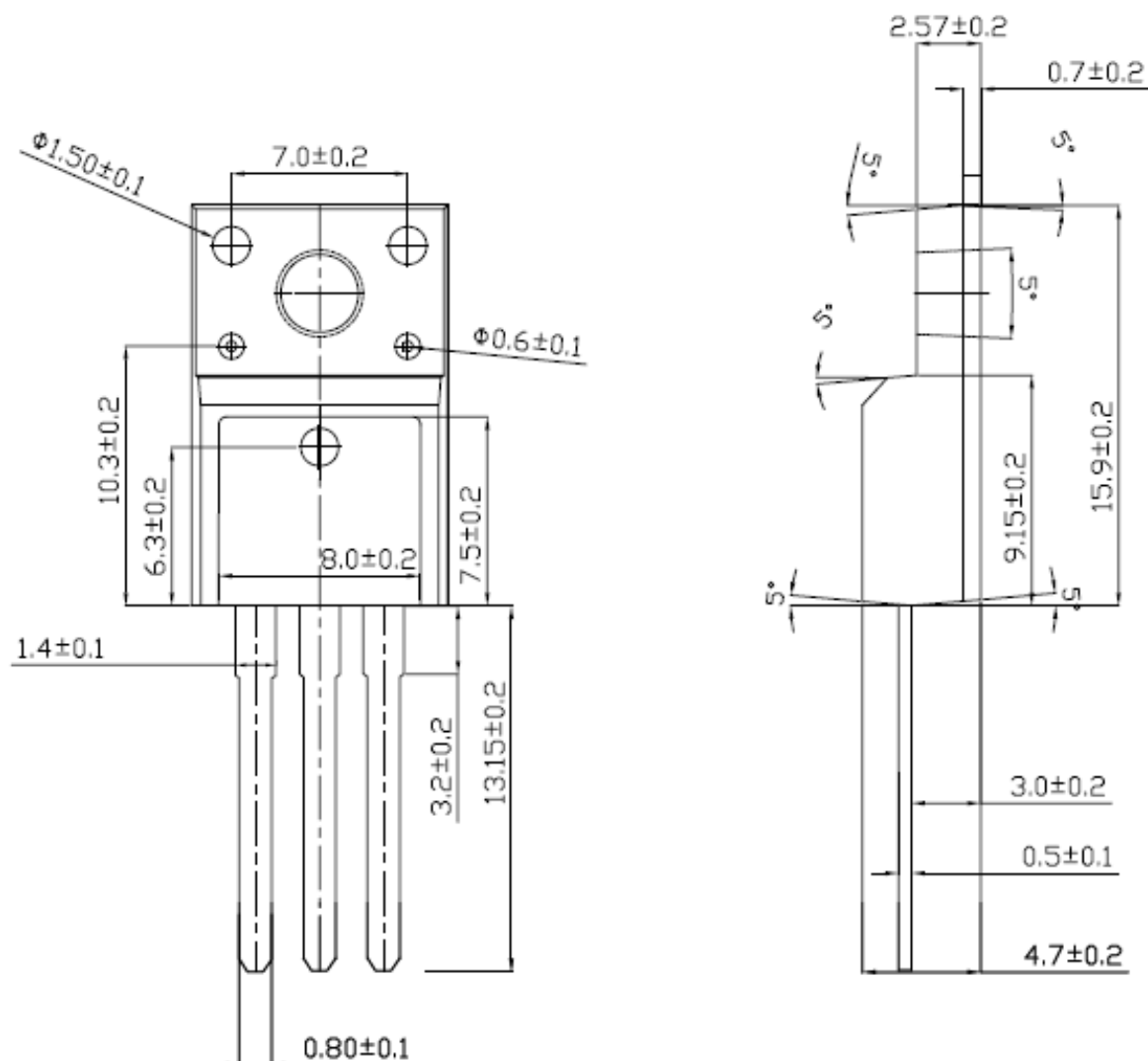


Figure 10. Transient Thermal Impedance  
TO-220

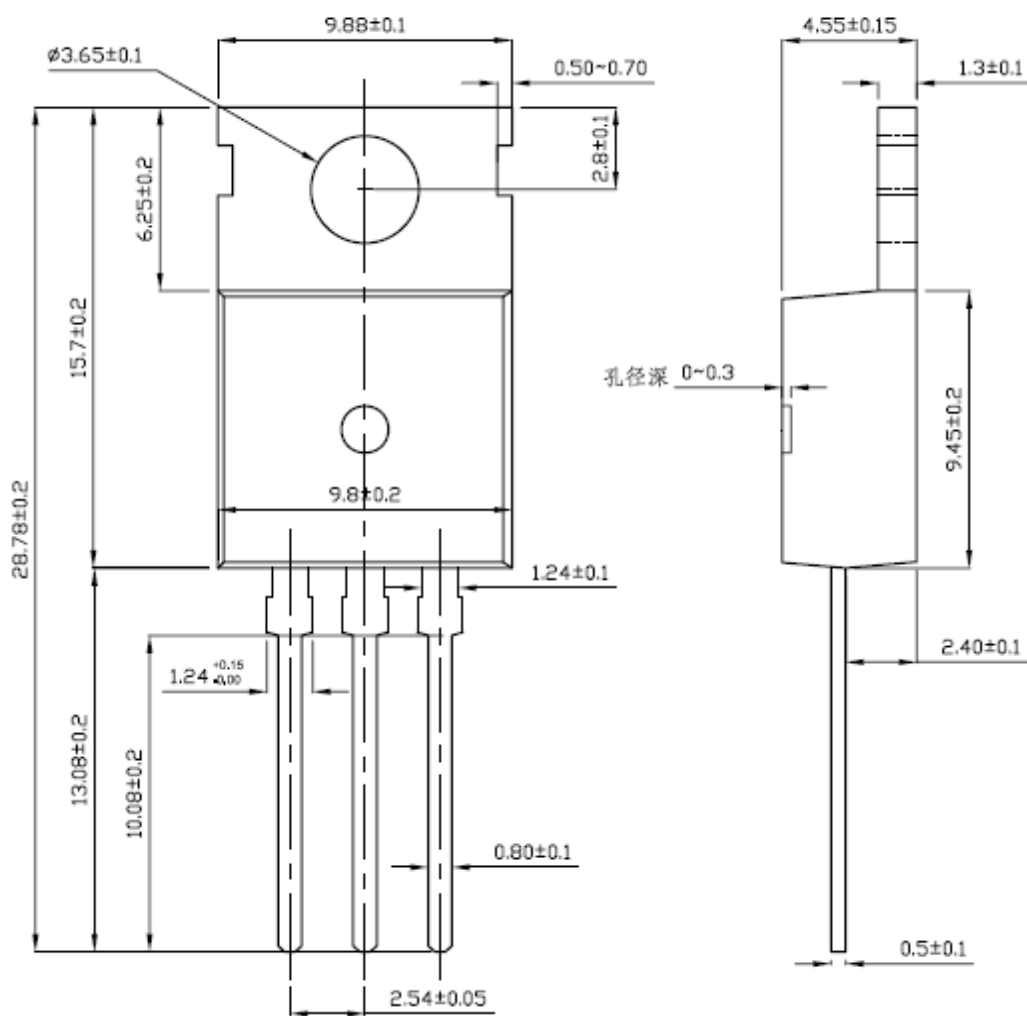


**Figure A: Gate Charge Test Circuit and Waveform**

**Figure B: Resistive Switching Test Circuit and Waveform**

**Figure C: Unclamped Inductive Switching Test Circuit and Waveform**


# TO-220F



## TO-220



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